

## **THE CLAIMS**

1. A fabrication method for arranging ultra-fine particles into arrays of wells, comprising:
  - a) providing a substrate;
  - b) forming wells with an aspect ratio of less than 0.37 through the surface of said substrate;
  - c) forming micelles containing nanoparticles; and
  - d) self-assembling the micelles in said wells.
2. The fabrication method of claim 1 in which the wells have an aspect ratio of less than or equal to 0.3.
3. The fabrication method of claim 1 wherein the nanoparticles are metal nanoparticles.
4. The fabrication method of claim 3 wherein the metal is cobalt.
5. The fabrication method of claim 1 wherein said nanoparticles have diameters of 0.5 to 500 nm and said wells are less than 1  $\mu\text{m}$  in diameter.
6. The fabrication method of claim 1 wherein the diameter of said micelles in dry condition is 0.01 to 1.0 times the diameter of said wells.
7. The fabrication method of claim 1 wherein the diameter of said micelles in solution is less than 1.5 times the diameter of said wells.
8. The fabrication method of claim 1 wherein said micelles are formed by steps comprising:
  - a) adding inverse micelles in a solution of hydrophobic liquid;
  - b) synthesizing nanoparticles within said inverse micelles; and
  - c) self-assembling the micelles in said wells.
9. The fabrication method of claim 8 in which the micelles are self-assembled in said wells by dipping said substrate into a solution of the micelles.

10. The fabrication method of claim 8 in which the micelles are self-assembled in said wells by spin-casting the micelles onto the surface of said substrate.
11. The fabrication method of claim 8 in which the hydrophobic liquid is toluene.
12. The fabrication method of claim 1 wherein the number of said nanoparticles within said wells is controlled by process parameters.
13. The fabrication method of claim 12 wherein the process parameters comprise a parameter selected from a group consisting of micelle concentration, time period for dip-coating, spinning speed for spin coating, temperature, solvent evaporation speed, selection of solvent, selection of micelle composition, selection of substrate, and selection of photoresist material.
14. The fabrication method of claim 1, wherein said wells are arranged in an ordered manner.
15. The fabrication method of claim 1, wherein said wells are arranged with periodicity.
16. The fabrication method of claim 1, wherein said wells are arranged in a random manner.
17. The fabrication method of claim 1 wherein said wells are formed using electron beam lithography.
18. The fabrication method of claim 1 wherein said wells are formed using UV irradiation.
19. The fabrication method of claim 1 wherein said wells are formed using holographic lithography.
20. The fabrication method of claim 1 wherein said wells are in the form of periodic elongate grooves.

21. The fabrication method of claim 1 wherein said wells are 100 – 200 nm deep.
22. A fabrication method for arranging ultra-fine particles into an array of wells, comprising:  
coating a GaAs substrate surface with a photo sensitive chemical resistant to acid;  
forming wells with aspect ratios less than 0.37 through the surface of said substrate using holographic lithography; and  
self-assembling micelles containing cobalt nanoparticles in said wells.
23. The fabrication method of claim 22 in which the micelles are self-assembled in said wells by dip casting.
24. The fabrication method of claim 22 in which the micelles are self-assembled in said wells by spin casting.
25. A fabricated device comprising:  
a substrate formed with wells through its surface, said wells having an aspect ratio of less than 0.37, micelles in said wells, and nanoparticles enclosed in said micelles.
26. The fabricated device of claim 25 in which said wells have an aspect ratio less than or equal to 0.3.
27. The fabricated device of claim 25 wherein the nanoparticles are metal nanoparticles.
28. The fabricated device of claim 27 wherein the metal is cobalt.
29. The fabricated device of claim 25 wherein said nanoparticles have a diameter of 0.5 to 500 nm and said wells are less than 1  $\mu\text{m}$  in diameter.
30. The fabricated device of claim 25 wherein the diameter of said micelles in dry condition is 0.01 to 1.0 times the diameter of said wells.

31. The fabricated device of claim 25 wherein the diameter of said micelles in solution is less than 1.5 times the diameter of said wells.

32. The fabricated device of claim 25 wherein said wells are arranged in an ordered manner.

33. The fabricated device of claim 25 wherein said wells are arranged in a random manner.

34. A fabricated device comprising:  
a GaAs substrate coated with a photoresist layer of a photo sensitive chemical resistant to acid formed with wells, having an aspect ratio of less than 0.37, through the surface of said substrate and said photoresist, and micelles within said wells, said micelles incorporating cobalt nanoparticles.

35. The fabricated device of claim 34 wherein said wells are in the form of periodic elongate grooves.

36. The fabricated device of claim 34 wherein said wells are 100 – 200 nm deep.